

developed, nearly as large as, and similar to, that in *C. tuberculatus*.

Upper inner incisors long and slender, with a second, very small, external cusp; upper outer incisor, on each side, very small, scarcely as long as the cingulum of the inner incisor. Second upper premolar close to the canine; the first small premolar in the angle between the canine and the second premolar, and visible only with aid of a lens. Lower incisors very small, trifold, not crowded. First lower premolar scarcely equal to half the second premolar in vertical extent.

Length (of an adult male preserved in alcohol), head and body 1.95 inch, tail 1.75, head 0.55, ear 0.4, tragus 0.18, forearm 1.4, thumb 0.25, second finger 2.5, fourth finger 1.9, tibia 0.6, foot and claws 0.3.

*Hab.* Queensland. Type in the collection of the British Museum.

XXVIII.—*Contributions to the Study of the chief Generic Types of the Paleozoic Corals.* By JAMES THOMSON, F.G.S., and H. ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S.E., Professor of Natural History in the University of St. Andrews.

[Continued from p. 128.]

[Plates XII., XIV., XV., XVI., & XVII.]

#### Genus LITHOSTROTION.

*Lithostrotion*, Lhwyd, Lithophyl. Britann. Ichnographia, epist. 5, tab. xxiii. 1699.

*Gen. char.* Corallum compound, fasciculate or astræiform. Corallites surrounded by a complete epitheca; an imperfect or ill-defined accessory wall is usually present. Septa well developed, the primary septa extending from the outer wall nearly to (or sometimes quite to) the columella. A compact, styliform, laterally compressed columella is present. Central area of each corallite formed by irregular, generally somewhat elevated tabulæ. Between the central tabulate area and the wall the interseptal loculi are filled with dissepiments, producing in longitudinal sections a series of small lenticular cells arranged in layers which are directed upwards and outwards.

The corallum in *Lithostrotion* is never simple. Sometimes it is fasciculate, and is composed of more or less cylindrical flexuous corallites; at other times the corallum is astræiform,

and is composed of amalgamated and polygonal corallites ; in some cases (as, for example, in *L. canadense*, Castelnau) the corallum is partly fasciculate and partly astræiform, or different specimens may be wholly the one or the other. In any case, the general form of the corallum does not appear to be a sufficient ground for generic distinction, though the fasciculate forms have repeatedly been placed in one genus and the astræiform in another.

The increase of the corallum is effected in the typical species of *Lithostrotion* by calicular gemmation, involving only a portion of the original calice, and allowing the old corallite to go on growing side by side with the new one. Lateral budding is also not uncommon, the new corallites produced in this way assuming a direction parallel to that of their parents, and growing up side by side with them. The genus *Stylaxis* was founded by Prof. M'Coy for species of *Lithostrotion* which were supposed to increase by fission of the old tubes. The appearance of fissiparous development in these cases seems, however, to be really due to the fact that the young corallites produced by calicular gemmation do not hinder the continued growth of the old corallites, but grow up alongside of them, the two quickly becoming united by their walls ; and even if fission were proved to occur occasionally, it would hardly afford of itself sufficient ground for generic distinction.

The epitheca is well developed and complete, marked with circular striæ and shallow annulations of growth. Sometimes the corallites of the fasciculate species inosculate with one another. If *L. Stokesi*, E. & H., be rightly referred to this genus, the corallites are in this species united by outward expansions of the epitheca ; whilst in *L. harmodites*, E. & H., they are united together by horizontal connecting processes, as in *Syringopora*. There are, however, some doubts as to the true affinities of these forms.

The septa extend from the inner surface of the wall to varying distances from the columella. A few of the primary septa sometimes actually reach the columella ; but most of them, together with all the secondary septa, fall short of it. The sides of the septa are plain and not denticulate ; and in the majority of cases the primary septa extend so far inwards as not to leave any conspicuous space in the centre of the visceral chamber occupied solely by the tabulæ. An inconspicuous septal fossula is sometimes present, as in *L. affine*, Fleni. ; and the somewhat aberrant *L. canadense*, Castelnau, is said to possess several small fossettes.

The columella is always present in each corallite, and has the form of a flattened, laterally compressed, compact rod, which

extends without interruption from the bottom of the visceral chamber to the floor of the calice. When cut across in longitudinal sections, the columella presents itself as a thin solid rod occupying the centre of the visceral chamber (Pl. XV. fig. 1 A).

Immediately exterior to the columella is a larger or smaller tabulate area, the tabulæ being often more or less bifurcated and irregular, whilst they are usually directed more or less upwards and inwards (Pl. XV. fig. 1 A). As already stated, the primary septa are continued through this tabulate area nearly to the centre of the corallites, so that the tabulæ are not exposed to view over a central space, as they are in *Diphyphyllum*.

The external area of each corallite is formed by vesicular tissue, constituted by delicate dissepiments, which intersect the interseptal loculi. These dissepiments do not interfere with the continuity of the septa as seen in cross sections (Pl. XIV. fig. 1); but as seen in longitudinal sections they form a series of minute lenticular cells, which are directed upwards and outwards (Pl. XV. fig. 1 A).

In general there does not seem to be any well-defined or perfectly developed accessory wall (in the sense that this structure exists in genera such as *Acervularia*, *Smithia*, *Chonaxis*, *Lonsdaleia*, *Endophyllum*, &c.). There is, however, often the appearance of an inner mural investment, due to the contrasted structure of the outer vesicular zone and the inner tabulate area at their point of junction.

The type species of the genus *Lithostrotion* is *L. basaltiforme*, Fleming (Pl. XIV. fig. 1). Amongst other forms, however, which exhibit all the essential characteristics of the genus, we may mention *L. aranea*, M'Coy, *L. Portlocki*, Bronn, *L. junceum*, Flem.\*, *L. fasciculatum*, Flem. (= *L. Martini*, E. & H.), *L. irregulare*, Phill., *L. affine*, Flem., *L. Phillipsi*, E. & H., and *L. arachnoideum*, M'Coy.

The genus *Lithostrotion* is such a comprehensive one, and the vicissitudes which it has undergone are so various, that we have thought it advisable to give here a brief summary of the more important facts in its history, which it may concern the palæontologist to be possessed of. The name of *Lithostrotion* was originally given by Edward Lhwyd to a coral from the Carboniferous Limestone, which appears to be

\* We do not feel certain that *Lithostrotion junceum*, Flem., can be retained in the genus *Lithostrotion*. In many respects it presents structural characters very different from those of *Lithostrotion* in its typical form; and it shows curious affinities with the genus *Heterophyllia*. We have this point, however, at present under consideration, and we shall give the results of our investigation at a later period.

the species now known as *L. basaltiforme*, and which must now stand therefore as the type of the genus (Lithophyl. Britann. Ichnograph., 1699).

In 1826, Goldfuss described and figured under the name of *Columnaria lævis* a fossil coral which would appear to be a *Lithostrotion* (Petref. Germ. tab. xxiv. fig. 8).

In 1828, Fleming employed Lhwyd's name of *Lithostrotion* for four corals—of which one is *L. basaltiforme*, another is a *Lithostrotion* but specifically undeterminable, whilst the remaining two are respectively a *Lonsdaleia* and an *Isastræa* (Brit. Anim. p. 508).

In 1832, Lesueur seems to have given the name of *Stylina* to a fossil coral subsequently described by Dale Owen (Geol. Survey of Wisconsin &c., pl. iv. figs. 5 & 6), from the Carboniferous Limestone of Iowa, under the name of *Lithostrotion basaltiforme*. The species appears to be *L. canadense*, Castelnau.

In 1836, Prof. Phillips described several species of *Lithostrotion* from the Carboniferous Limestone of Yorkshire (Geol. Yorkshire, vol. ii. pl. ii.). *L. basaltiforme* appears under the name of *Cyathophyllum basaltiforme*; but the other species are referred to *Lithodendron*. In this latter reference, however, Prof. Phillips departed entirely from the characters of the genus *Lithodendron* as originally defined by Schweigger (Beobachtungen, Syst. tab. vi.); and though subsequently followed by Lonsdale, his course in this respect cannot be sustained.

In 1843, Castelnau gave the name of *Axinura* to the fasciculate corals placed by Phillips in *Lithodendron* (Terr. Silur. de l'Amér. du Nord); and in 1845 Mr. Lonsdale expanded and redefined *Lithodendron* to include the same species of *Lithostrotion* (Murch., Vern. & Keys. 'Russia and Ural,' Appendix A, p. 597). In the same work Mr. Lonsdale proposed to divert the name of *Lithostrotion* from the fossil originally figured by Lhwyd under this title, and to apply it to the corals now known as *Lonsdaleia*. He also founded the new genus *Stylastræa* for fossils which he believed to be identical with Lhwyd's coral; and he created the genus *Diphyphyllum* for some corals of an internal structure nearly the same as that of *Stylastræa*, but of a fasciculate form.

In 1846, Prof. Dana proposed to apply the name of *Columnaria*, Goldfuss, to the corals now known as *Lithostrotion* (Expl. Exp., Zooph. p. 363).

In 1849, Prof. M'Coy published a valuable paper on Carboniferous corals (Ann. & Mag. Nat. Hist. 2nd series, vol. iii.), in which he dealt with various corals now usually referred to *Lithostrotion* in the following manner:—(1) He did not accept the genus *Lithostrotion* at all; and he referred the *Lithostro-*

tion of Lonsdale (= *Lonsdaleia*) to the genus *Strombodes*, Schweigger. (2) He accepted the genera *Stylastræa* and *Diphyphyllum* of Lonsdale. (3) He founded the genus *Nematophyllum* (subsequently changing its name to *Nematophyllum*) for a group of corals of which *N. arachnoideum* is the type, and which are clearly astræiform species of *Lithostrotion*. (4) He proposed the name of *Stylaxis* for corals which are stated to differ from the preceding by their supposed fissiparous development, and which are also clearly referable to *Lithostrotion* as now understood. (5) He proposed the name of *Siphonodendron* for the corals referred by Phillips to *Lithodendron*, which are now regarded as fasciculate species of *Lithostrotion*.

In 1850, M. D'Orbigny founded the genera *Acrocyathus* and *Lasmocyathus* for forms subsequently referred by Edwards and Haime to *Lithostrotion*.

In 1850, Milne-Edwards and Haime (Brit. Foss. Cor. Intr. p. lxxi.) accepted the genera *Nematophyllum*, M'Coy, and *Lithodendron*, Phill., separating the two principally by the alleged presence of a well-developed accessory wall in the former, and rejecting *Stylaxis*, M'Coy. They further applied the name of *Lithostrotion* to the corals which we now term *Lonsdaleia*. In 1851 (Pol. Foss. des Terr. Pal.) the same authors accepted the genus *Stylaxis*, M'Coy; they defined the genus *Lonsdaleia* as at present accepted; and they extended to the genus *Lithostrotion* nearly its modern signification, placing under it *Lithodendron*, Phill., *Siphonodendron*, M'Coy, and *Nematophyllum*, M'Coy.

In 1851, Prof. M'Coy published his great work (Brit. Pal. Foss.), in which he adhered to the views which he had previously expressed with regard to the affinities of this group of corals.

In 1852, Milne-Edwards and Haime still further expanded their definition of *Lithostrotion*, to which they now referred the genus *Stylaxis*, M'Coy (Brit. Foss. Cor. p. 191). At the same time, they founded the genus *Petalaxis* for the corals which they had previously described under the names of *Stylaxis* M'Coyana and *S. Portlocki*; and they further rejected the genera *Stylastræa* and *Diphyphyllum* of Lonsdale.

In 1859, Mr. Billings gave reasons for retaining the genus *Diphyphyllum*, Lonsd., showing that it is properly separable from *Lithostrotion*, and that the absence of the columella, which forms one of its distinguishing characters, is not accidental, as believed by Milne-Edwards and Haime (Can. Journ. new ser. vol. iv. p. 133).

In 1861, De Fromental ('Polypiers Fossiles') restricted the



name of *Lithostrotion* to those species of the genus which have an astræiform corallum, whilst he placed the fasciculate forms under the head of *Diphyphyllum*. The same author likewise separated some of the astræiform species of *Lithostrotion*, together with the two species of *Petalaxis*, E. & H., and placed them under the revived genus *Stylaxis*, M'Coy, upon the wrongly alleged ground that the septa are not continued into the external vesicular area. This grouping, however, is in all respects an objectionable one.

In 1872, Prof. de Koninck (Anim. Foss. Nouv. Recherches, p. 26) defined the genus *Lithostrotion* in most essential respects as done by Milne-Edwards and Haime. He rightly shows, however, that *Diphyphyllum*, Lonsd., is to be separated from *Lithostrotion*, and he adds the synonym of *Teniodendrocyclus* (Ludwig, Palæontographica von H. von Meyer, p. 220, 1866).

Finally, in 1873, Dybowski (Mon. der Zoanth. scler. rug. aus der Silurform. Esthlands &c.) proposed the following grouping of these forms :—(1) the genus *Lithodendron*, Phill., is restored, though upon no sufficient grounds stated. (2) The genus *Lithostrotion* is defined in the same general sense as by Milne-Edwards and Haime, *Diphyphyllum*, Lonsd., being excluded. (3) The genus *Petalaxis*, Edw. & H., is defined as having a quadrate columella, as having the septa confined to the centre of the visceral chamber and separated from the wall by large-sized vesicles, and as having a simple corallum—none of these characters, however, entering into the definition given by Milne-Edwards and Haime, or appearing in the illustrations published by these authors.

As regards the genera allied to *Lithostrotion*, its closest ally (in the matter of external appearance at any rate) is *Diphyphyllum*, Lonsd. In this latter genus, however, there is never any columella, and the septa always leave a conspicuous central tabulate area uncovered and exposed to view. Nor are these structural features accidental or in any way due to peculiarities in the mode of fossilization of particular specimens; but they are of constant occurrence even in the most excellently preserved examples. Indeed the two genera in question attain their maximum in different formations, *Diphyphyllum* being principally Devonian, whilst *Lithostrotion* is essentially and almost exclusively Carboniferous. It need hardly be added that there can be no risk of confounding *Diphyphyllum* with *Lithostrotion*, except as regards the fasciculate species of the latter, since none of the former are known to possess an astræiform corallum.

The genus *Stylastræa* was founded by Lonsdale (Murch., Vern. & Keys., Russia & Ur., Append. p. 619) to include

certain Carboniferous corals which agree with *Diphyphyllum* in the absence of a columella, in the comparatively short septa, in the possession of a central exposed area of tabulæ, and in the other details of their internal structure, but which are astræiform in their mode of growth. This genus is rejected by Milne-Edwards and Haime (Brit. Foss. Cor. p. 192) upon the same grounds which induce them to abandon *Diphyphyllum*; and they consider it to have been founded upon astræiform species of *Lithostrotion*. Not having seen Mr. Lonsdale's original specimens, we cannot hazard a positive opinion; but we are inclined to believe that he could hardly have made any mistake about the absence of a columella and the comparatively undeveloped septa of *Stylastræa*; and therefore we do not think that this genus can be regarded as a synonym of *Lithostrotion*. In the meanwhile, however, we leave it an open question whether *Stylastræa*, Lonsd., can be retained, or whether it should not rather be merged with the genus *Diphyphyllum*.

From the fasciculate and astræiform species of *Cyathophyllum* the genus *Lithostrotion* is at once distinguished by the fact that there is no true columella in the former, whilst the septa, typically, meet in the centre and become twisted together.

From *Acervularia*, Schweigger, *Smithia*, E. & H., *Columnaria*, Goldf. (= *Favistella*, Hall), and *Palæophyllum*, Billings, the genus *Lithostrotion* is fundamentally separated, amongst other characters, by its possession of a columella.

*Phillipsastræa*, D'Orb., is compared by Milne-Edwards and Haime (Pol. Foss. des Terr. Pal. p. 447) to the astræiform species of *Lithostrotion*, in which, however, the outer wall is wanting, so that the corallites become confluent by their septa. The true affinities of *Phillipsastræa* appear, on the other hand, to be rather with *Heliophyllum* than with *Lithostrotion*; and it seems very doubtful if a true columella is really present in the genus. What has been taken for the columella seems to be only a pseudo-columella formed by a projection of the tabulæ or by the septa; and even this is often wanting.

From *Lonsdaleia*, M'Coy, and its allies *Chonaxis*, E. & H., and *Axophyllum*, E. & H., the genus *Lithostrotion* is separated by its simple compact columella, and the fact that the septa extend without interruption through the external vesicular zone.

The genus *Koninckophyllum*, Thomson and Nicholson, is distinguished from *Lithostrotion* by its being generally simple, and by the much greater development of the peripheral zone of vesicular tissue, though it approximates to the latter in the structure of the columella. It is also distinguished by the septa not being developed to the same extent.

The genus *Petalaxis*, E. & H., lastly, has been but imperfectly defined (Brit. Foss. Cor., Intr. p. lxxi, under the name of *Nematophyllum*); and it seems difficult to determine precisely what characters its authors wished to assign to it. So far, however, as can be judged from the descriptions and figures of the two species \* embraced under this name (viz. *P. M' Coyana*, E. & H., and *P. Portlocki*, E. & H.), the genus would not appear to be separated by sufficient characters from *Lithostrotion* proper.

With the exception of a single species (*L. antiquum*, Bronn), which is believed to be of Devonian age, all the known species of *Lithostrotion* are referable to the Carboniferous period, where they constitute one of the most abundant and characteristic groups of corals.

#### Genus KONINCKOPHYLLUM, Thomson and Nicholson.

*Gen. char.* Corallum simple or compound. Septa well developed, but not reaching the centre, united externally by numerous delicate dissepiments, which give rise to an exterior zone of dense vesicular tissue. Tabulæ occupying a central area of considerable size, into which the septa are only very partially, or not at all, continued. A styliform, compact or subcompact columella. Occasionally a septal fossula. In the compound forms increase is by calicular gemmation.

We have believed ourselves justified in founding this genus for the reception of certain corals from the Carboniferous rocks of Scotland, which present a combination of characters peculiarly their own, and which may be regarded as, in some respects, intermediate between *Cyathophyllum* and *Lithostrotion*. We have named the genus in honour of Prof. de Koninck, whose work amongst the Palæozoic corals has so deservedly contributed to the high reputation which he has obtained in various branches of palæontology.

The corallum in *Koninckophyllum* is sometimes simple, and sometimes compound. When simple, it is usually of small size, rarely exceeding two inches in length, and it is conical,

\* These species were originally described by Milne-Edwards and Haime (Pol. Foss. p. 453) under the names of *Stylaxis M' Coyana* and *S. Portlocki*, and were transferred subsequently to *Petalaxis* (Brit. Foss. Corals, p. 205). Under any circumstances, these species must not be confounded with the forms known as *Lithostrotion M' Coyanum* and *L. Portlocki*, Bronn. These latter are entirely distinct from the former, and are retained in *Lithostrotion* in the last grouping of the genus proposed by Milne-Edwards and Haime. If *Petalaxis* be abandoned and relegated to *Lithostrotion*, then the specific names of *M' Coyana* and *Portlocki* applied to the two species of the genus will have to be changed.



cylindrical, or cylindro-conical in form. When compound, the corallum is usually fasciculate; and its mode of increase is by calicular gemmation, the young corallites being always produced near the periphery of the old calices (Pl. XII. figs. 1 & 3).

The epitheca is thin and complete, marked with fine encircling striæ and shallow accretion-ridges. The calice is moderately deep, its margin being sometimes thin, at other times thick and everted.

In the centre of the visceral chamber is a small, compressed, compact, or sometimes imperfectly cellular, styliform columella, which forms a small projection in the floor of the calice (Ann. & Mag. Nat. Hist., Feb. 1876, Pl. VIII. fig. 8). As seen in longitudinal sections, the columella (Pl. XII. figs. 2 A, 3 A, & 6 A) forms a distinct thin line, which usually runs from the bottom of the visceral chamber to the floor of the calice as a continuous rod. Sometimes, however, it is absent or interrupted over portions of its course (figs. 3 A & 6 A). It was at first difficult to determine whether this was due to any real want of continuity, or whether it was not caused by flexures of the corallum taking the columella at places out of the line of section; but it seems to be really due to the former cause. As seen in transverse sections (Pl. XII. figs. 1, 2, 4, & 5), the columella is shown to be markedly compressed laterally.

The central area of the corallum is occupied by tabulæ, over the upper surfaces of which the septa do not extend, or only to a very limited extent. The tabulæ are very close-set, often inosculating or almost vesicular, and usually distinctly elevated just before they are pierced by the columella. The result of this last-mentioned peculiarity is that a transverse section cuts through more than one of the tabulæ in the immediate vicinity of the columella. Hence in transverse sections (Pl. XII. figs. 2 & 4) the columella is seen to be surrounded by the divided edges of several of the tabulæ, which might lead to the erroneous impression that the columella is composed of twisted lamellæ, though longitudinal sections clearly prove that this is not the case. In no case do the tabulæ extend to the inner surface of the wall, though the central area which they occupy is one of very considerable dimensions.

The septa (Pl. XII. figs. 1-6) are well developed, but always fall short of the columella by a considerable space. Hence, though they infringe upon the margins of the tabulate area, they are never continued to the centre, and they invariably leave the tabulæ exposed to view over a conspicuous median space. A septal fossula, containing a single short septum, is often present.

Externally, the septa are united by numerous close-set delicate dissepiments, which are sometimes rectangular, sometimes finely anastomosing and reticulate (Pl. XII. figs. 1-6). The dissepiments give rise to an exterior zone of vesicular tissue of an extremely dense and minute character. As seen in longitudinal sections (figs. 2 A, 3 A, 6 A), the vesicles of this zone are exceedingly small lenticular cells, which are arranged in layers directed upwards and outwards from the central tabulate area.

As regards the relationships of the genus, *Koninckophyllum* may be said to be distinguished by characters of an unusually fundamental nature. In some respects it is nearly allied to *Diphyphyllum* and to some of the forms of *Cyathophyllum* (such as *C. paracida*, McCoy); but it is broadly separated from these genera by the possession of a well-developed, compact and styliform columella. From *Lophophyllum*, E. & H., it is distinguished by the totally different form and connexions of the columella, and the less developed condition of the septa, and, even more strikingly, by its extraordinarily minute and dense zone of vesicular tissue forming the periphery of the corallum. From *Lithostrotion*, again, it is separated by the much more rudimentary state of the septa, the greater development of the vesicular zone, and the fact that the corallum is always compound in the former, whilst it is usually simple in the latter.

There remains, finally, only the genus *Axophyllum*, E. & H., which need be considered here, though its characters are such as really to render its separation from *Koninckophyllum* a matter of no difficulty, as will be at once seen by a reference to the annexed woodcut and the subjoined description. The corallum



Longitudinal section of *Axophyllum Konincki*, E. & H., the type species of the genus *Axophyllum*. After Milne-Edwards and Haime.

in *Axophyllum* is always simple, turbinate in form, with a complete epitheca. The centre of the visceral chamber is occupied by a strong cylindrical columella, of comparatively gigantic size, and formed of numerous vertical, spirally twisted lamellæ. Hence, on longitudinal section, the columella appears as a cylindrical cellular mass of large size. The columella pierces a central area, occupied by strong remote tabulæ and surrounded by an accessory wall. The space between the inner mural investment and the true wall is occupied by dissepiments, giving rise to an exterior zone of large vesicles. The septa are well developed, and extend to the centre of the visceral chamber. It will be seen from the above that the structure of *Koninckophyllum* is entirely different from that of *Axophyllum*, as defined by Milne-Edwards and Haime (Pol. Foss. des Terr. Pal. p. 455) and by De Koninck (An. Foss. Nouv. Recherches, partie i. p. 23). Under these circumstances it is unnecessary to add that the compound forms of *Koninckophyllum* cannot be confounded with *Lonsdaleia*, the latter having incomplete septa, which are not connected with the external wall, and having a columella of a different structure.

So far as our present knowledge goes, the species of *Koninckophyllum* appear to be exclusively confined to the Lower Carboniferous rocks. All our specimens are from Scotland (Brockley, near Lesmahagow; Charleston, Fifeshire; and Dunbar, Haddingtonshire). The compound forms are sometimes found in vast numbers, covering very extensive areas. The description of the various species of this genus we reserve for another communication.

#### Genus LONSDALEIA.

*Lonsdaleia*, M'Coy, Ann. & Mag. Nat. Hist. ser. 2, vol. iii. p. 11.

*Gen. char.* Corallum compound, fasciculate or astræiform, increasing by calicular gemmation. Each corallite is provided with a distinct wall; and an inner mural investment is usually developed. The centre of the visceral chamber is occupied by a very large, somewhat cylindrical columella, formed of twisted lamellæ. A well-developed tabulate area of close-set tabulæ, surrounded by an exterior vesicular zone of large-sized vesicles. The septa are present in the central area, most of them falling short of the columella; but they are not continued through the peripheral vesicular zone to the outer wall.

The corallum in *Lonsdaleia* is invariably compound, and is either astræiform or fasciculate. The young corallites are produced by calicular gemmation, the new buds arising in the outer vesicular zone of the parent corallite, and the latter con-

tinuing to grow uninterruptedly onwards. In some forms (as *L. duplicata*, Mart.) the corallites always remain completely free laterally (Pl. XVI. fig. 2); in others (as *L. floriformis*, Flem.) they become united laterally, and assume a polygonal form from mutual pressure (Pl. XVI. fig. 3); whilst in *L. rugosa*, M'Coy, there is an intermediate state of parts, and the corallites, though usually free laterally, sometimes become more or less amalgamated (Pl. XVII. fig. 1).

The corallites are always enclosed in a complete epitheca of greater or less thickness, which exhibits fine encircling striae and often well-marked accretion-ridges.

The central area of the corallum is occupied by well-developed tabulae, which are seen in longitudinal sections (Pl. XVII. fig. 1) to be extremely close-set. They often anastomose with one another, and are very distinctly elevated as they approach the columella. Hence in transverse sections (Pl. XVI. figs. 1 A & 2 A) the divided edges of a greater or less number of the tabulae may be seen surrounding the columella.

The tabulae are pierced centrally by the columella, which runs continuously from the bottom of the visceral chamber to the floor of the calice, where it appears as an elevated acutely conical prominence. The columella is of large size, approximately cylindrical in shape, and composed of numerous twisted plates, which appear to become continuous laterally with the tabulae, as shown by longitudinal sections (Pl. XVII. fig. 1). In transverse sections (Pl. XVI. figs. 1-3) the columella is seen as a conspicuous central cellular mass, the outer portion of which is formed by concentric lines disposed in successive sectors.

The space between the central tabulate area and the inner surface of the wall is occupied by vesicular tissue. The vesicles of this zone are of comparatively very large size; and they are formed by strongly arched plates, the convexities of which are turned upwards, and which are seen in longitudinal sections (Pl. XVII. fig. 1) to have a direction outwards and upwards. In transverse sections (Pl. XVI. figs. 1-3) the divided edges of the vesicles of this zone form an exceedingly conspicuous feature, partly from their large size and partly because they are unencumbered by the septa. A distinct accessory wall is sometimes clearly present, intervening between the central tabulate area and the outer vesicular zone. In other cases the apparent inner mural investment seems to be little more than an appearance produced by the contrast of structure between the central tabulate area and the peripheral zone of vesicular tissue at their line of junction.



The septa are present in a well-developed form in the exterior portion of the tabulate area, but do not exist at all in the outer vesicular zone, or only extend into the latter region in a very rudimentary and imperfect form (Pl. XVI. figs. 1-3). Secondary septa are usually, if not always, present; and the primary septa for the most part stop short at a little distance from the columella. In some cases, however, a few of the primary septa seem to be continued inwards as far as the columella. When viewed in transverse sections (Pl. XVI. figs. 1 A, 2 A, & 3 A), the septa are seen to be united by delicate transverse dissepiments, which, however, are not developed between the septa in their inward extension, and become sparse and irregular as the septa are traced outwards to the outskirts of the vesicular zone.

The genus *Lonsdaleia* was first clearly defined by Prof. M'Coy (*loc. cit.*); but he included only the fasciculate forms under this name, and erroneously referred the astræiform species to *Strombodes*. The essential structural characters of the genus, however, had at an earlier date been fully recognized by Mr. Lonsdale (Murch. Vern. & Keys. Russ. & Ur. p. 602); but he considered that the name of *Lithostrotion* was the one properly applicable to these corals. Milne-Edwards and Haime (Brit. Foss. Cor. p. 190) first showed that the name of *Lithostrotion* should properly be applied to the group of corals of which *L. basaltiforme* is the type; and in this they have been supported by most subsequent writers on the subject. Fromentel, however, took the retrograde step of separating the astræiform species under the name of *Stylidophyllum* (Polypiers Foss. p. 316); and Dybowski has so far adopted the same course as to restrict the name of *Lonsdaleia* solely to the same species (Mon. der Zoanth. scler. rug. p. 83).

The zoological characters of the genus *Lonsdaleia* are so well marked that there is little chance of its being confounded with any other. From the true *Strombodes*, Schweig., from *Spongophyllum*, E. & H., and from *Endophyllum*, E. & H., it is at once distinguished, amongst other characters, by its possession of a columella. From *Lithostrotion* and *Diphyphyllum* it is separated by the fact that the septa are not in direct connexion with the outer wall; whilst the latter genus has no columella, and this organ in the former genus appears as a compact styliform rod. By far the nearest allies of *Lonsdaleia*, as at present understood, are *Chonaxis*, E. & H., and *Axophyllum*, E. & H. The former of these appears to differ from *Lonsdaleia* solely, or chiefly, in the fact that the external walls are wanting, and the corallites are united together directly by the amalgamation of their vesicular zones. The genus *Axophyllum*,

again, as described and figured by Milne-Edwards and Haime, appears to differ in no essential structural character from *Lonsdaleia*, from which it is separable chiefly by its being simple instead of compound. If this identity of structure should be confirmed by further investigation, it will become very doubtful if the genus *Axophyllum* can be retained; but we have at present no sufficient means of arriving at a final judgment on this point. From the description given by Prof. de Koninck, on the other hand (An. Foss. Nouv. Recherches, p. 23), it would seem that the septa of *Axophyllum* are in connexion with the outer wall, which would constitute a sufficient distinction from *Lonsdaleia*. Another ally of *Lonsdaleia*, in a somewhat unexpected quarter, is found in the genus *Clisiophyllum*, Dana. Both these genera have a distinct columellary line, and possess a few lamellæ, which spring from near the inner margins of the primary septa, and are connected by a system of endothecal dissepiments. On the other hand, *Lonsdaleia* is distinguished from *Clisiophyllum* by being compound, by increasing by calicular gemmation, by the fact that the septa are not connected with the external wall, and by the large size of the vesicles of the exterior vesicular zone. Finally, the genus *Koninckophyllum*, Thoms. & Nich., is distinguished from *Lonsdaleia* by the fact that the septa are directly connected with the outer wall, by the different nature of the columella, and by the minute and dense vesicular tissue of the outer zone, as well as by the generally simple nature of the corallum.

In its range the genus *Lonsdaleia* is restricted, not having been hitherto found to transcend the limits of the Carboniferous rocks.

#### EXPLANATION OF THE PLATES.

(Unless otherwise stated, the figures are of the natural size.)

#### PLATE XII.

- Fig. 1.* *Koninckophyllum prokiferum*, Thomson and Nicholson, transverse section of a small slab exhibiting the different stages of growth by calicular gemmation. Lower Carboniferous, Bathgate, Linlithgowshire.
- Fig. 2.* *Koninckophyllum magnificum*, Thomson and Nicholson, transverse section of an exceptionally large example; 2 A, longitudinal section of the same, exhibiting the columellary line, the large tabulate area, and the dense outer vesicular zone. Lower Carboniferous, Charleston, Fifeshire.
- Fig. 3.* Transverse section of *Koninckophyllum interruptum*, Thoms. and Nich. The section is cut about a quarter of an inch below the floor of the calice, and does not show any signs of the columella, proving that this organ is really absent occasionally in portions of the corallum: the septa also are seen to be wanting at certain points: and these vacant spaces are the bases of young

corallites budded off from the disk of the calice. 3 A, longitudinal section of the same, showing the absence of the columella in the upper portion of the corallum and its presence in the lower portion. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.

Fig. 4. *Koninkophyllum Lindströmi*, Thomson and Nicholson, transverse section; the external vesicular tissue is extraordinarily dense, and the columella is apparently connected with the septum occupying the septal fossula. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.

Fig. 5. *Koninkophyllum radiatum*, Thomson and Nicholson, transverse section. Lower Carboniferous, Charleston, Fifeshire.

Fig. 6. *Koninkophyllum retiforme*, Thomson and Nicholson, transverse section, showing the rectangular dissepiments and the septal fossula occupied by two short septa; the columella is imperfectly cellular. 6 A, longitudinal section of the same. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.

[Figs. 8, 8 A, and 8 B of the preceding portion of this paper, 'Annals,' February 1876, Pl. VIII., are illustrations of *Koninkophyllum magnificum*. Fig. 8 shows the floor of the calice, with the protuberant columella; fig. 8 A is a transverse section of the same; and fig. 8 B is a longitudinal section, showing the columellary line, with the elevated tabulæ around it.]

#### PLATE XIV.

Fig. 1. *Lithostrotion basaltiforme*, Flem., a transverse section, showing a portion of the internal structure and the aspect of the calices. Lower Carboniferous, Arbigland, Dumfriesshire.

Fig. 2. *Lithostrotion Portlocki*, Bronn, transverse section of a small slab; 2 A, longitudinal section of the same; 2 B, a few of the corallites enlarged. Lower Carboniferous, Dunbar.

Fig. 3. *Lithostrotion M'Coyanum*, E. & H., transverse section of a small slab. Lower Carboniferous, Penrith, Cumberland.

Fig. 4. *Lithostrotion Flemingii*, M'Coy: the crown of the dome-shaped mass is ground away, exhibiting the arrangement of the septa and, towards the margin, the calices. Lower Carboniferous, Arbigland, Dumfriesshire.

#### PLATE XV.

Fig. 1. *Lithostrotion Phillipsi*, E. & H., transverse section of a small slab; 1 A, longitudinal section of the same, showing the columellary line. The absence of the columella in parts is due to the flexuous form of the corallites. Lower Carboniferous, Arbigland, Dumfriesshire.

Fig. 2. *Lithostrotion Martini*, E. & H., transverse section of an unusually large variety. Lower Carboniferous, Arbigland, Dumfriesshire.

Fig. 3. *Lithostrotion irregulare*, Phill., transverse section of a small slab. Lower Carboniferous, Boghead, near Lesmahagow.

Fig. 4. *Lithostrotion junceum*, Flem., longitudinal section of a small slab; 4 A, transverse section of a small slab of the same; 4 B, a few of the corallites enlarged, showing the peculiar arrangement of some of the primary septa. Lower Carboniferous, Brockley, Lesmahagow.

#### PLATE XVI.

Fig. 1. *Lonsdaleia rugosa*, M'Coy, transverse section of small slab, showing the development, from the young corallite emerging from

the oral disk of the parent to the perfect corallite; 1 A, the central corallite of the preceding, enlarged, with two young corallites. Main Limestone (Lower Carboniferous), Boghead, Lesmahagow.

Fig. 2. *Lonsdaleia duplicata*, Mart., transverse section of a small slab; 2 A, two of the corallites enlarged. Lower Carboniferous, near Muirkirk.

Fig. 3. *Lonsdaleia floriformis*, Flem., transverse section of a small slab; 3 A, two of the corallites enlarged. Lower Carboniferous, Bathgate, Linlithgowshire.

#### PLATE XVII.

Fig. 1. *Lonsdaleia rugosa*, McCoy, longitudinal section of three corallites, taken from a large slab; 1 A, a corallite, showing the acutely conical boss formed by the columella in the floor of the calice, and the columellary line in the centre; 1 B-1 F, corallites in various stages of growth, arising from the outer vesicular tissue. The different appearance presented by different portions of the section is due to the flexuous form of the corallites. Main Limestone (Lower Carboniferous), Boghead, Lesmahagow.

XXIX.—*Description of a new Species of the Genus Merula from the Fiji Islands.* By E. L. LAYARD, C.M.G., H.B.M. Consul for Fiji and Tonga, F.Z.S., &c. &c.

#### *Merula vitiensis*, n. sp.

Some months since my kind friend Mr. A. Tempest, among a collection of birds made by him for me at Bua, on the large island of Vanua Levu, gave me a specimen of a "Blackbird," which at the time I identified, from the short description in the 'Ornithologie der Viti-, Samoa- und Tonga-Inseln' of Drs. Finsch and Hartlaub, as *Merula vanicoroensis*. The acquisition by myself, at Samoa, of specimens of that bird, at once, however, showed me that I had committed an error; and I hasten to rectify it.

The Fiji bird, which I propose to call *Merula vitiensis*, is of a silky smoky brown above, not nearly so dark as *vanicoroensis*; below, it is grey-brown, with the same silky lustre; throat and side of neck grey; the centre of the belly has some feathers tinged with ruddy brown; bill and legs bright pale yellow. Length 7" 6", wing 4" 3", tail 3" 2", tarse 1" 5", bill 1" 2".

Mr. Tempest describes this bird as being extremely shy and difficult to procure, in notes and habits resembling the European bird, scratching on the ground under bushes. The nest also is said to resemble that of *M. vulgaris*.